MATERIAL SAFETY DATA SHEET

1. SUBSTANCE AND SOURCE IDENTIFICATION

National Institute of Standards and Technology
Standard Reference Materials Program
100 Bureau Drive, Stop 2320
Gaithersburg, Maryland 20899-2320

MSDS Coordinator: Mario J. Cellarosi
Telephone: 301-975-6776
FAX: 301-926-4751
E-mail: SRMMSDS@nist.gov

SRM Number: 3144
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SRM Name: Rhodium Standard Solution

Date of Issue: 09 June 2006

Emergency Telephone ChemTrec:
1-800-424-9300 (North America)
+1-703-527-3887 (International)

Description: This Standard Reference Material (SRM) is intended for use as a primary calibration standard for the quantitative determination of rhodium. One unit of SRM 3144 consists of five 10-mL sealed borosilicate glass ampoules of an acidified aqueous solution prepared gravimetrically to contain a known mass fraction of rhodium. The solution contains hydrochloric acid at a volume fraction of approximately 10 %.

Material Name: Rhodium Standard Solution

Other Designations:

Rhodium: Rh; elemental rhodium; rhodium metal
Rhodium Chloride: Trichlororhodium; rhodium trichloride; rhodium (III) chloride
Hydrochloric Acid: Hydrogen chloride; aqueous hydrochloric acid, muriatic acid.

2. COMPOSITION AND INFORMATION ON HAZARDOUS INGREDIENTS

Component	CAS Registry	EC Number (EINECS)	Concentration (%)
Hydrochloric Acid	7647-01-0	231-595-7	10
Rhodium Chloride	10049-07-7	233-165-4	2.3
Rhodium	7440-16-6	231-125-0	1

EC Classification, R/S Phrases: Refer to Section 15, Regulatory Information.

3. HAZARDS IDENTIFICATION

NFPA Ratings (Scale 0-4): Health = 3 Fire = 1 Reactivity = 1

Major Health Hazards: Hydrochloric acid can cause severe or fatal burns if inhaled, swallowed, or absorbed through the skin. The toxicity of rhodium and rhodium nitrate has not been fully investigated, but both can cause irritation and allergic reactions.

Physical Hazards: Glass container may break or shatter.

Potential Health Effects

Inhalation: Inhalation of HCl may cause death due to inflammation, spasm, and edema of the larynx and bronchi. Symptoms of exposure include burning sensation, coughing, wheezing, laryngitis, shortness of breath, headache, nausea, and vomiting. Chemical pneumonitis, pulmonary edema, cyanosis, and rapid breathing may occur. The teeth, nasal passages, and other tissues may be damaged. Exposure to rhodium and its compounds may irritate the upper respiratory tract, but no serious health effects have been reported. Respiratory sensitization may occur after prolonged exposure to metal fumes.

Skin Contact: Hydrochloric acid can cause severe burns, but it is not absorbed through the skin. Rhodium and its compounds may cause skin irritation with contact urticaria (hives) and possible allergic sensitization.

Eye Contact: Hydrochloric acid can cause severe burns and permanent eye damage. Rhodium may cause temporary eye irritation, but eye damage has not been reported. Rhodium chloride may cause eye damage.

Ingestion: Hydrochloric acid can cause severe corrosive injury to the mucous membranes and GI tract. Internal bleeding may cause a drop in blood pressure. Other effects may include shock, metabolic acidosis, and circulatory collapse. The toxicity of rhodium is not fully understood, but ingestion of rhodium compounds may irritate the GI tract, causing abdominal pain, nausea, vomiting, and diarrhea.

Medical Conditions Aggravated by Exposure: Any pre-existing conditions affecting the skin, eyes, respiratory tract, or other target organs.

Listed as a Carcinogen/ Potential Carcinogen:

	Yes	No
In the National Toxicology Program (NTP) Report on Carcinogens		X
In the International Agency for Research on Cancer (IARC) Monographs		X
By the Occupational Safety and Health Administration (OSHA)		X

Note: Water-soluble rhodium compounds have caused tumors in laboratory animals.

4. FIRST AID MEASURES

Inhalation: Move the person to fresh air immediately. If not breathing, qualified personnel may start CPR or give oxygen if necessary. Get medical aid at once, and bring the container or label.

Skin Contact: Remove contaminated clothing and shoes. Flush affected skin with water for at least 15 minutes, then wash thoroughly with soap and water. If burns are severe or if skin irritation persists, get medical aid and bring the container or label. Wash contaminated clothing before reusing.

Eye Contact: Remove contact lenses (if any). Do not allow victim to rub eyes or keep eyes closed. Flush eyes with large amounts of running water for at least 30 minutes, keeping eyelids open and raising lids to remove all chemical. Get medical aid at once, and bring the container or label.

Ingestion: Contact a poison control center immediately for instructions. Wash out mouth with water, but do not induce vomiting. Get medical aid at once, and bring the container or label.

5. Fire Fighting Measures

Fire and Explosion Hazards: Hydrochloric acid is a negligible fire hazard when exposed to heat or flames, but it reacts with many metals to produce flammable hydrogen gas. It also reacts with water to produce heat. Hydrogen chloride gas is heavier than air and may accumulate in low areas. **Extinguishing Media:** Use extinguishing media appropriate to the surrounding fire: water spray, dry chemical, carbon dioxide, or foam. Use a water spray to dilute hydrochloric acid. (These guidelines apply to the mixture; when the components are considered separately, different precautions may apply.)

Fire Fighting: Avoid inhalation of material or combustion byproducts. Wear full protective clothing and NIOSH-approved self-contained breathing apparatus (SCBA).

Flash Point (°C): N/A

Autoignition (°C): N/A

Flammability Limits in Air: N/A

Lower Explosive Limit (LEL): N/A

Upper Explosive Limit (UEL): N/A

Flammability Class (OSHA): N/A

6. Accidental Release Measures

Occupational Release: Notify safety personnel of spills. Surfaces contaminated with this material should be covered with soda ash or sodium bicarbonate to neutralize the acid and to prevent the formation of potentially explosive hydrogen gas. Place the neutralized material into containers suitable for eventual disposal, reclamation, or destruction. Empty containers may retain hazardous product residues. Do not flush to sewer.

Disposal: Refer to Section 13, Disposal Considerations.

7. Handling and Storage

Storage: Store unopened containers of this material in a dry place with acid-resistant flooring at room temperature. Protect from physical damage, direct sunlight, heat, and incompatible materials. Ampoules should be stored in an upright position.

Safe Handling Precautions: Wear gloves and chemical safety goggles (Section 8). Engineering controls should maintain airborne concentrations below TLV (Section 8).

8. Exposure Controls and Personal Protection

Hydrochloric Acid

ACGIH TLV-TWA: 5 ppm or 7 mg/m^3

OSHA PEL: 5 ppm or 7 mg/m^3

NIOSH PEL: 5 ppm or 7 mg/m^3

UK WEL-TWA: 2 mg/m^3

Rhodium Chloride (insoluble form):

ACGIH TWA: 1 mg/m^3

OSHA TWA: 0.1 mg/m^3

UK WEL: 0.1 mg/m^3

Rhodium

ACGIH TWA: 1 mg/m^3

OSHA TWA: 0.1 mg/m^3

UK WEL: 0.1 mg/m^3

Ventilation: Use local or general exhaust to keep employee exposures below limits. Local exhaust ventilation is preferred because it can control contaminant emissions at the source, preventing dispersion into the general work area. Refer to the ACGIH document *Industrial Ventilation, a Manual of Recommended Practices*.

Respirator: If necessary, refer to the NIOSH document *Guide to the Selection and Use of Particulate Respirators Certified under 42 CFR 84* for selection and use of respirators certified by NIOSH.

Eye Protection: Use chemical safety goggles where dusting or splashing of solutions may occur. See OSHA standard (29 CFR 1910.133) or European Standard EN166. The employer should provide an emergency eye wash fountain and safety shower in the immediate work area.

Personal Protection: Wear appropriate gloves and protective clothing to prevent contact with skin.

9. PHYSICAL AND CHEMICAL PROPERTIES

Hydrochloric Acid	Rhodium Chloride	Rhodium
Appearance and Odor: Colorless liquid; pungent, irritating odor (may be undetectable at PEL).	**Appearance and Odor:** Red, deliquescent powder, hygroscopic; slight chlorine odor	**Appearance and Odor:** White lustrous solid
Relative Molecular Weight: 36.46	**Relative Molecular Weight:** 209.26 (anhydrous)	**Relative Molecular Weight:** 102.91
Molecular Formula: HCl	**Molecular Formula:** $RhCl_3$	**Molecular Formula:** Rh
Specific Gravity: 1.05 (10%)	**Bulk Density:** 5380 kg/m^3	**Specific Gravity:** 12.41
Solvent Solubility: Soluble in alcohol and benzene	**Solvent Solubility:** Anhydrous form is soluble in alkali hydroxide or cyanide solutions. Trihydrate form is soluble in hydrochloric acid, methanol, and ethanol.	**Solvent Solubility:** Soluble in concentrated sulfuric acid, fused potassium bisulfate, sulfuric acid/ hydrochloric acid solutions
Water Solubility: Soluble, with slight evolution of heat	**Water Solubility:** Anhydrous form is insoluble in water; trihydrate form is highly soluble.	**Water Solubility:** Insoluble
Boiling Point (°C): 53 (127°F)	**Boiling Point (°C):** 717 (1323˚F)	**Boiling Point (°C):** 3727 (6740ºF)
Melting Point (°C): -74 (-101°F)	**Melting Point (°C):** 450 (842˚F)	**Melting Point (°C):** 1966 (3571ºF)
Vapor Pressure (kPa): 25 @25°C	**Vapor Pressure (Pa):** N/A	**Vapor Pressure (Pa):** 1 @ 2015˚C (3659˚F).
Vapor Density (Air=1): N/A	**Vapor Density (Air=1):** N/A	**Vapor Density (Air=1):** N/A
Critical Solution Temperature: N/A	**Critical Solution Temperature:** N/A	**Critical Solution Temperature:** N/A
pH: 1.0 (0.1M solution)	**pH:** Aqueous solution is acidic	**pH:** N/A

NOTE: The physical and chemical data provided are for the pure components. Physical and chemical data for this solution do not exist. The actual behavior of the solution may differ from the individual components.

10. STABILITY AND REACTIVITY

Stability: __X__ Stable _____Unstable

Stable at normal temperatures and pressure.

Conditions to Avoid: Heat, light, moisture, incompatible materials.

Incompatible Materials:

Hydrochloric Acid: Incompatible with cyanides, metals, hydroxides, amines, bases, metal cyanides, oxidizing materials, acids, halocarbons, combustible materials, halogens, and metal salts. HCl reacts with many metals to produce flammable hydrogen gas. It also reacts with water to produce heat.

Rhodium Chloride: Incompatible with oxidizing materials. A violent reaction occurs if a methanol solution of $RhCl_3$ comes in contact with zinc and iron pentacarbonyl.

Rhodium: Incompatible with halogens and oxidizing materials; reacts violently with chlorine, bromine pentafluoride, bromine trifluoride, and fluorine monoxide.

Fire/Explosion Information: See Section 5.

Hazardous Decomposition: Thermal decomposition of hydrochloric acid may release acid halides. Thermal decomposition of rhodium and rhodium chloride may release rhodium oxides and other products.

Hazardous Polymerization: _____ Will Occur __X__ Will Not Occur

11. TOXICOLOGICAL INFORMATION

Route of Entry: __X__ Inhalation __X__ Skin __X__ Ingestion

Hydrochloric Acid:

Human, inhalation: LC_{Lo} (30 min) = 1300 mg/kg
Human, inhalation: LC_{Lo} (5 min) = 3000 mg/kg
Rat, inhalation: LC_{Lo} (24 hrs) = 685 Φg/m^3
Rat, oral: LD_{50} = 700 mg/kg (31.5% in water)

Rhodium Chloride:

Rat, oral: LD_{50} = 1302 mg/kg

Rhodium: No acute toxicity data found.

Target Organ(s): Respiratory tract, GI tract, skin, eyes, teeth, immune system (sensitizer).

Mutagen/Teratogen: The reproductive effects of hydrochloric acid have not been fully investigated. Rhodium trichloride has caused mutations in bacteria and tumors in laboratory animals.

Health Effects: See Section 3.

12. ECOLOGICAL INFORMATION

Hydrochloric Acid: When released to water, HCl is ionized. Neutralization depends on the buffer capacity of the water. In the atmosphere, HCl is absorbed in cloud droplets and transformed to Cl-, with a half-life of 5.5 days. The solubility of HCl indicates a high mobility in soil.

Bluegill (*Lepomis macrochirus*): LC_{50} (96 hrs) = pH 3.5
Mosquitofish (*Gambusia affinis*): LC_{50} (96 hrs) = 282,000 µg/L
Common Shrimp (*Crangon crangon*): LC_{50} (48 hrs) = 260,000 µg/L

Rhodium Chloride: No acute ecotoxicity data found.

Rhodium: No acute ecotoxicity data found.

Environmental Summary: This mixture may be slightly toxic to aquatic life. The environmental effects of rhodium and its compounds have not been fully evaluated. Do not release this material to the environment.

13. DISPOSAL CONSIDERATIONS

Waste Disposal: One or more components of this mixture is a RCRA hazardous waste. Dispose of container and unused contents in accordance with federal, state, and local requirements for acid waste, which vary according to location. Decontaminate containers before recycling. Processing, use, or contamination of this product may change the waste management options.

14. TRANSPORTATION INFORMATION

U.S. DOT and IATA:

Hydrochloric Acid Solution, Hazard Class 8, UN1789, Packing Group II

15. REGULATORY INFORMATION

U.S. REGULATIONS

CERCLA Sections 102a/103 (40 CFR 302.4):

Hydrochloric Acid: RQ = 5000 lbs.
Rhodium: Not regulated.
Rhodium Chloride: Not regulated.

SARA Title III Section 302: Hydrochloric acid is regulated in anhydrous or gas form only.

SARA Title III Section 304: Hydrochloric acid is regulated in anhydrous or gas form only.

SARA Title III Section 313: Hydrochloric acid is regulated in anhydrous or gas form only.

OSHA Process Safety (29 CFR 1910.119): Hydrochloric acid is regulated (TQ = 5000 lbs).

SARA Title III Sections 311/312 Hazardous Categories (40 CFR 370.21):

ACUTE:	Yes
CHRONIC:	Yes
FIRE:	No
REACTIVE:	Yes
SUDDEN RELEASE:	No

STATE REGULATIONS

California Proposition 65: None of the components are regulated.

CANADIAN REGULATIONS

WHMIS Classification:

Hydrochloric Acid: D1A (very toxic material), E (corrosive material)
Rhodium Chloride: D2B (toxic)
Rhodium: D2B (toxic)

WHMIS Ingredient Disclosure List: All three components are regulated.

CEPA Domestic Substances List (DSL): All three components are regulated.

EUROPEAN REGULATIONS

EU/EC Classification:

Hydrochloric Acid: T (Toxic), C (Corrosive)
Rhodium Chloride: Xn (Harmful); not classified in Annex I of Directive 67/548/EEC.
Rhodium: Xn (Harmful); not classified in Annex I of Directive 67/548/EEC.

Risk Phrases (mixture):

R23 (toxic by inhalation)
R25 (toxic if swallowed)
R35 (causes severe burns)
R36/37/38 (irritating to eyes, respiratory system and skin)
R43 (may cause sensitization)

Safety Phrases (mixture):

S26 (rinse and seek medical advice after contact with eyes)
S28 (wash after contact with skin)
S36/37/39 (wear suitable protective clothing)
S45 (in case of accident or illness, see doctor; show label)

NATIONAL INVENTORY STATUS

U.S. Inventory (TSCA): All components are listed.

TSCA 12(b), Export Notification: None of the components are listed.

16. OTHER INFORMATION

Sources:

Hazardous Substances Data Bank (HSDB): Rhodium and Rhodium Compounds.

PAN Pesticides Database: Hydrogen Chloride.

U.S. Agency for Toxic Substances and Disease Registry (ATSDR): Medical Management Guidelines for Hydrogen Chloride (HCl).

U.S. National Institute for Occupational Safety and Health, *NIOSH Pocket Guide to Chemical Hazards*, September 2005 edition. DHHS (NIOSH) Publication No. 2005-151.

Disclaimer: Physical and chemical data contained in this MSDS are provided only for use as a guide in assessing the hazardous nature of the material. The MSDS was prepared carefully, using current references; however, NIST does not certify the data in the MSDS. The certified values for this material are given in the NIST Certificate of Analysis.